AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		3

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0001	31 OCT 2001		

6. ISSUED BY CODE

US ARMY ENGINEER DISTRICT, FORT WORTH
ATTN: CESWF-CT (RM 2A19)
PO BOX 17300
FORT WORTH, TX 76102-0300

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE FACILITY CODE

(X)

9A. AMENDMENT OF SOLICIATION NO.
DACA63-02-B-0003

☒ 9B. DATED *(SEE ITEM 11)*
12 OCTOBER 2001

10A. MODIFICATION OF CONTRACT/ORDER NO.

☐ 10B. DATED *(SEE ITEM 11)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for COMMAND AND CONTROL FACILITIES, FORT HOOD, TEXAS, is amended as follows:

See Continuation Sheet.

NOTE: The Bid Opening date and time remain "14 November 2001, at 2 p.m., local time," as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

Item 14. Continued.

CHANGES TO THE SPECIFICATIONS

1. New Sections - Add the following accompanying new section, bearing the notation "ACCOMPANYING AMENDMENT NO. 0001 TO SOLICITATION NO. DACA63-02-B-0003:"

SECTION 07131 ELASTOMERIC MEMBRANE WATERPROOFING

2. Replacement Sections - Replace the following sections with the accompanying new sections of the same number and title, bearing the notation "ACCOMPANYING AMENDMENT NO. 0001 TO SOLICITATION NO. DACA63-02-B-0003:"

SECTION 02467 DRILLED PIERS
SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE
SECTION 04200 MASONRY
SECTION 09915 COLOR SCHEDULE
SECTION 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

CHANGES TO THE DRAWINGS

3. General Note to the drawings - Sequence numbers are off by two for the bookmarked Drawings and for the Index of Drawings (Text File) beginning with Volume Two of the solicitation drawings. The Volume Two cover and index drawings should be listed as G3 and G4 respectively and are mistakenly listed as Seq 165 & 166. Seq 165 actually begins with sheet M1.

4. Replacement Drawings.- Replace the drawings listed below with the attached new drawings of the same number, bearing the notation "AM #0001":

c07a.cal	Seq 9	C7A	CONSTRUCTION PHASING PLAN- BASE BID & BID OPTION
c08.cal	Seq 10	C8	LAYOUT PLAN - BASE BID
a49.cal	Seq 94	A49	ROOM FINISH SCHEDULE - Company Ops
a50.cal	Seq 95	A50	ROOM FINISH SCHEDULE - Battalion Command
a51.cal	Seq 96	A51	ROOM FINISH SCHEDULE - Brigade HQ
i01.cal	Seq 108	I01	"FURN & FLOOR PATTERN PLAN TYPE A, C, E"
i02.cal	Seq 109	I02	"FURN & FLOOR PATTERN PLAN TYPE B, D, F"
i03.cal	Seq 110	I03	PARTIAL FURN AND FLOOR PATTERN PLAN
i06.cal	Seq 113	I06	PARTIAL FURNITURE AND FLOOR PATTERN PLAN
s13.cal	Seq 138	S13	FOUNDATION SECTIONS II
s14.cal	Seq 139	S14	FOUNDATION SECTIONS III
s27.cal	Seq 152	S27	REINFORCED CMU NOTES & DETAILS
s28.cal	Seq 153	S28	FOUNDATION PLAN TYPE A
s29.cal	Seq 154	S29	FOUNDATION PLAN TYPE B & D
s30.cal	Seq 155	S30	FOUNDATION PLAN TYPE C & E
s31.cal	Seq 156	S31	FOUNDATION PLAN TYPE F
s32.cal	Seq 157	S32	PARTIAL FOUNDATION PLAN
s33.cal	Seq 158	S33	PARTIAL FOUNDATION PLAN
s34.cal	Seq 159	S34	PARTIAL FOUNDATION PLAN
s35.cal	Seq 160	S35	PARTIAL FOUNDATION PLAN
s36.cal	Seq 161	S36	PARTIAL FOUNDATION PLAN
s37.cal	Seq 162	S37	FOUNDATION SECTIONS I
s38.cal	Seq 163	S38	FOUNDATION SECTIONS II
s39.cal	Seq 164	S39	FOUNDATION SECTIONS III
m07.cal	Seq 171	M7	BATTALION HVAC DUCT WORK
m10.cal	Seq 174	M10	BRIGADE HVAC DUCT WORK
m12.cal	Seq 176	M12	COMPANY OPS MECHANICAL ROOM PIPING

m13.cal	Seq 177	M13	BOILER AND CHILLER PIPING
m25.cal	Seq 189	M25	MS-05: MECH DISTRIBUTION DETAILS II
e30.cal	Seq 234	E30	BRIGADE HQ COMMUNICATION & FIRE ALARM PLANS - AREA 1
e43.cal	Seq 247	E43	FIRE ALARM RISER DIAGRAMS ALL BUILDINGS

END OF AMENDMENT

SECTION 02467

DRILLED PIERS
9/2000
AMENDMENT 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent specified. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616/A 616M	(1996) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

1.2 QUALIFICATIONS

The work shall be performed by a specialty Contractor, specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions.

1.3 SUBSURFACE DATA

Subsurface data logs are shown on the drawings. The subsurface investigation report is available for examination at the Fort Worth District Office. Samples of subsurface materials may be available for examination at the Southwestern Division Laboratory, Dallas, Texas, and/or at locations within the Fort Worth District confines. Upon request, these samples will be made available. The request should reach the Fort Worth District Office at least three (3) days prior to the time of requested examination date.

1.4 MEASUREMENT AND PAYMENT

1.4.1 Drilled Piers

Drilled foundation piers will be measured by the linear meter for depths actually drilled in strict conformance to the requirements of the specification and drawings. The length of drilled piers will be measured from the authorized bottom of the bells to their upper termination at the bottom of the grade beam, slab, pier cap, or any formed portion of the pier above grade, as applicable. Payment for drilled foundation piers will be made at the applicable contract unit price per linear meter according to diameter. This payment shall constitute full compensation for all plant, labor, materials, and all costs necessary for drilling, casing, and furnishing and placing steel and concrete, complete, except for belling work including additional concrete for bells indicated below.

1.4.2 Belling Piers

Payment for belling the drilled foundation piers will be included in the contract price for the structure to which the work pertains, which payment shall constitute full compensation for labor, plant, materials, and all costs necessary to enlarge the pier holes to form the bells, including concrete in the enlarged portions.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Drilled Piers;

A certified copy of the survey. Lines and levels shall be established and caisson centerline locations staked and maintained by a registered surveyor. **(Am0001)**

Qualifications;

Qualifications of the foundation system Contractor shall show that he has been engaged in the successful installation of drilled foundation caissons or piers for at least 5 years.

SD-11 Closeout Submittals

Drilled Piers;

Detailed records in an approved form, for each pier, showing shaft and bell diameters, depths of test holes, top and bottom elevations, bearing strata description, casing description, water conditions, concrete strength, concrete volume, rock elevations, dates of excavation and concrete placement, and other pertinent information. Upon completion of pier work, the Contractor shall provide a record of centerline locations based on the survey of the registered surveyor. **(Am0001)** In addition, corrective measures shall be similarly recorded. A complete tabulation of all records pertaining to approved piers shall be delivered to the Contracting Officer.

1.6 SUPERVISION, INSPECTION, AND SAFETY

1.6.1 Contractor Supervision

The Contractor shall provide for the supervision of all phases of drilled pier construction. Supervision shall be the Contractor's responsibility as outlined in Quality Control provisions of Section 01451 CONTRACTOR QUALITY CONTROL. Each drilled pier excavation shall be checked by the Contractor for its depth, water removal, cleanup, workmanship, and for all tolerance requirements before any concrete is placed.

1.6.2 Government Inspection

The Contracting Officer reserves the right to inspect each drilled pier excavation prior to placement of reinforcing steel and concrete. The Contractor shall furnish the Contracting Officer all necessary equipment required for proper inspection of drilled pier excavations. This inspection in no way relieves the Contractor of his responsibilities as

outlined in CONTRACT CLAUSE "INSPECTION OF CONSTRUCTION."

1.6.3 Safety Precautions for Workmen and Inspectors

The Contractor shall provide and operate all equipment required by the Contracting Officer to allow visual inspection of pier excavations by workmen or the Government, including equipment for personnel entering the excavation. Sufficient approved equipment shall be maintained to raise and lower Contractor and Government personnel into the excavation whenever required. All such equipment and all procedures used for personnel entering pier excavations shall strictly comply with all requirements of the applicable safety manuals.

1.6.3.1 Life Line

Each person entering a drilled pier excavation shall be provided with a life line rigged so that the person can be immediately hoisted out of the excavation in an emergency. The life line shall be suitable for instant rescue, securely fastened to a shoulder harness, and separated from any line used to remove excavated materials. No person shall be lowered into a drilled pier excavation prior to casing the shaft through the overburden.

1.6.3.2 Ventilation

Each drilled pier excavation shall be provided with a ventilating device of sufficient capacity to assure a safe and healthy atmosphere before workmen and inspectors are permitted to enter the drilled pier excavation and during all work periods.

PART 2 PRODUCTS

2.1 CONCRETE WORK

Concrete work shall be in accordance with requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE, as modified herein:

2.1.1 Coarse Aggregate

Maximum size of coarse aggregate shall be 20 mm.

2.1.2 Reinforcing Steel

Reinforcing steel shall conform to ASTM A 615/A 615M, ASTM A 616/A 616M, ASTM A 617/A 617M, Grade 60. Steel shall be tied into cages and inserted securely in the drilled pier shaft, in position and alignment, as shown, prior to concrete placement.

2.1.3 Strength

Concrete strength shall be 21 MPa at 28 days. Slump shall be not less than 125 mm nor more than 175 mm.

PART 3 EXECUTION

3.1 PREPARATION

a. Excavation of piers or groups of piers shall be performed so that the excavation and the placement of reinforcing steel and concrete are a continuous operation performed the same day that the excavation is started. Excavations shall not be left open overnight. Drilled piers shall be excavated to the depths and dimensions shown in the drawings. The bottoms of the pier excavation shall be cleaned of loose and disturbed materials or

materials determined to be unsatisfactory for the required bearing pressure. Excavated material shall be disposed of in accordance with Section 02315 EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. Excavations below indicated depths, without specific direction by the Contracting Officer, shall be filled with concrete at no cost to the Government. Where, in the opinion of the Contracting Officer, materials are encountered at the indicated depths that do not provide the required bearing capacity or would result in unsatisfactory construction, the excavation shall be extended as directed by the Contracting Officer. Payment for the additional excavation and pier construction will be in accordance with PART 1 paragraph MEASUREMENT AND PAYMENT.

b. The drilling equipment shall be of suitable type and of sufficient size and capacity to satisfactorily perform the required drilling operations as specified or indicated. All equipment shall be subject to specific approval by the Contracting Officer. Any equipment which fails to perform satisfactorily shall be immediately modified as approved or removed and replaced.

3.2 INSTALLATION

a. During construction, the pier excavation shall be adequately and securely protected against cave-ins, displacement of the surrounding earth, and inflow of ground and surface water by means of temporary steel casings as required or as directed by the Contracting Officer. Casings shall have outside diameters not less than indicated shaft sizes, and shall be capable of sustaining loads imposed by installing, sealing, maintaining the excavated hole, and extracting. The casing shall have a minimum wall thickness of 6.4 mm (1/4-inch). The ends of the casing shall not be damaged such that proper seating and sealing are impaired. Damaged casing shall be immediately repaired or removed from the site. Temporary steel casings shall be withdrawn, as the concrete is being placed, maintaining sufficient head of concrete within the casing to offset water table and to prevent extraneous material from falling in from the sides or entering from beneath casing and mixing with concrete. Casings may be jerked upward a maximum of 100 mm to break the bottom seal but shall thereafter be removed with a smooth, continuous motion. All voids surrounding the casing shall be filled with concrete extruded from the bottom of the casing as it is being raised, with all free water surrounding the casing being forced to the surface ahead of the rising concrete. Venting shall be provided if necessary to insure removal of water around the casing as the concrete level rises, and the casing is being removed. Driving of casings shall not be permitted within 6 meters of concrete Placed within the preceding 3 days.

b. The inside of steel casings shall be thoroughly cleaned before being placed in a pier hole.

c. Pier holes shall be protected from inflow of ground or surface water. Water that flows into the excavations shall be continuously removed and the maximum permissible depth of water in the bottom of excavation will be 50 mm at the start of concrete placement. In the event that excessive water enters the hold, the excavation shall be deepened to undisturbed material immediately prior to concrete placement.

d. Drilled piers shall be underreamed to the dimensions shown in the drawings. All pier underreams shall be measured using pier underream calipers specifically designed for this purpose and approved by the Contracting Officer.

e. Concrete shall be placed in the pier hole within three hours after approval of the completed excavation. Concrete shall be continuously placed by methods that insure against segregation and dislodging of excavation sidewalls and shall completely fill the bell and shaft.

Concrete shall be placed by pumps, tremie, or drop chutes. The discharge of pumping chute shall be kept a minimum of 75 mm below the fresh concrete surface during placement.

f. Concrete shall be vibrated for not less than the upper **1.5 m (Am0001)** of pier.

g. Protection shall be provided around the top of the excavation to prevent debris and water from entering the excavation and concrete placed therein.

3.3 TOLERANCES

a. Any pier out of center or plumb beyond the tolerance specified shall be corrected as necessary to comply with the tolerances and the Contractor shall bear any cost of correction. Method of correction shall be approved by the Contracting Officer.

b. Cross sections of shafts and bells shall not be less than design dimensions. Cross sections of shafts and bells shall not be greater than design dimensions plus 75 mm unless approved or directed by the Contracting Officer.

c. Location of the tops of installed piers shall not deviate from the centerline locations shown on the drawings more than 75 mm.

d. Vertical piers shall be installed plumb within a maximum of 35 mm for the first 3 meters and within **13 mm(Am 0001)** for each 3 meters of additional depth.

e. The center of the pier will be established after construction is completed and the center marked by a suitable permanent mark.

f. Batter piers shall be installed a maximum of 2 percent of length from specified inclination.

3.4 PROTECTION

Provide protection around top of the excavation to prevent debris from being dislodged into the excavation and concrete.

-- End of Section --

SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE
09/95
AMENDMENT 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(1987) Guide for Structural Lightweight Aggregate Concrete
ACI 214.3R	(1988) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 303R	(1991) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made From Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1998) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(19999a) Concrete Aggregates
ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1999) Ready-Mixed Concrete
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1998) Slump of Hydraulic Cement Concrete
ASTM C 150	(1998a) Portland Cement
ASTM C 171	(1997a)

	Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(1998) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 330	(1999) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 496	(1996) Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 567	(1999a) Unit Weight of Structural Lightweight Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595	(1998) Blended Hydraulic Cements
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(1998a) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1998) Chemical Admixtures for Use in

	Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete
ASTM C 1240	(1999) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar and Grout
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 1155M	(1996) Determing Floor Flatness and Levelness Using the F-Number System (Metric)

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type

COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

1.2 UNIT PRICE CONTRACT

1.2.1 Measurement

Measurement of concrete for payment will be made on the basis of the actual volume within the pay lines of the structure as indicated on the contract drawings. Measurement for payment of concrete placed against the sides of any excavation without intervening forms will be made only within the pay lines of the structure as shown on the contract drawings. No deductions will be made for rounded or beveled edges, for space occupied by metal work, for conduits, for voids, or for embedded items which are less than 0.15 cubic meters in volume or 0.09 square meters in cross section.

1.2.2 Payment

Unless otherwise specified, payment for concrete will be made at the respective unit prices per cubic meter for the various items of the schedule, measured as specified above, which price shall include the cost of all labor, materials, and the use of equipment and tools required to complete the concrete work, except for any reinforcement and embedded parts specified to be paid separately. Unit price payment will not be made for concrete placed in structures for which payment is made as a lump sum.

1.3 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Lightweight Aggregate Concrete;

Written recommendations from lightweight aggregate supplier on batching and mixing cycles.

Dry Shake Finish;

Manufacturer's written instructions on application of dry shake material 15 days prior to start of construction.

SD-04 Samples

Surface Retarder;

Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications;

Written documentation for Contractor Quality Control personnel.

1.5 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or

Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.6 FIELD TEST PANELS

Field test panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, additional panels shall be constructed until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

1.6.1 Sample Wall Panels

One sample panel at least 1220 mm by 1525 mm and 150 mm thick shall be constructed to demonstrate Class A formed finish and a similar one for Class B formed finish. Panels shall be located in an area approved by the Contracting Officer. Each panel shall include a full length and full width joint line and shall have at least two voids each at least 300 mm by 300 mm by 75 mm deep either impressed in the concrete as placed or chipped in the hardened concrete. After the concrete is 7 days old, the voids shall be patched to demonstrate the effectiveness and the appearance of the Contractor's repair procedures.

1.6.2 Slab Panels

A slab panel at least 1220 mm by 1525 mm and 100 mm thick shall be constructed to demonstrate exposed aggregate slab finish and a similar panel for extra high class slab finish. Panels shall be located in an area approved by the Contracting Officer. Each panel shall have a full length joint line.

1.7 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction on any concrete work. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.8 GENERAL REQUIREMENTS

1.8.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.8.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish
Very Flat	Same. Use only with F-system

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.8.1.2 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.5.6 and 4.5.6.1 of ACI 117/117R. The Contractor shall furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155M . The Contractor shall perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Contracting Officer. The tolerances of surfaces beyond the limits of ASTM E 1155M (the areas within 600 mm of embedments and construction joints) shall be acceptable to the Contracting Officer. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.5.6 and 4.5.6.1 of ACI 117/117R.

Bullfloated-	Areas ALL
Straightedged-	Areas ALL
Float Finish-	Areas ALL
Trowel Finish-	Areas ALL
Very Flat-	Areas NONE

1.8.1.3 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Bullfloated	13
Straightedged	8
Float Finish	5
Trowel Finish	3

1.8.2 Strength Requirements and w/c Ratio

1.8.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
21 MPa at 28 days	except at vehicular slabs.

Concrete slabs on-grade shall have a 28-day flexural strength of 4.5 MPa. Concrete made with high-early strength cement shall have a 7-day strength

equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39. Flexural strength shall be determined in accordance with ASTM C 78.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa.A "test" is

defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.8.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.50	All areas unless noted otherwise.

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.8.3 Air Entrainment

Except as otherwise specified for lightweight concrete, all normal weight concrete shall be air entrained to contain between **3 and 5(Am0001)** percent total air**. (Am0001)**

1.8.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143.

Structural Element	Slump Minimum	Slump Maximum
Walls, columns and beams	50 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping: At pump **(Am0001)**	50 mm	150 mm

When use of a plasticizing admixture conforming to ASTM C 1017 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added.

1.8.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

1.8.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.8.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.8.8 Technical Service for Specialized Concrete

The services of a factory trained technical representative shall be obtained to oversee proportioning, batching, mixing, placing, consolidating, and finishing of specialized structural concrete, such as the use of admixtures in concrete. The technical representative shall be on the job full time until the Contracting Officer is satisfied that field controls indicate concrete of specified quality is furnished and that the Contractor's crews are capable of continued satisfactory work. The technical representative shall be available for consultation with, and advice to, Government forces.

1.9 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.9.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the

equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance withASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.9.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.9.3 Proportioning Studies for Lightweight Aggregate Structural Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except as follows. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.2, using at least three different cement contents. Trial mixes shall be proportioned to produce air dry unit weight and concrete strengths specified in paragraph GENERAL REQUIREMENTS. Trial mixtures shall be proportioned for maximum permitted slump and air content. Test specimens and testing shall be as specified for normal weight concrete except that shall be determined from test cylinders that have been air dried at 50 percent relative humidity for the last 21 days. Air dry unit weight shall be determined in accordance with ASTM C 567 and shall be designed to be at least 32 kg per cubic meter less than the maximum specified air dry unit weight in paragraph GENERAL REQUIREMENTS. Curves shall be plotted using these results showing the relationship between cement factor and strength and air dry unit weight. Normal weight fine aggregate may be substituted for part or all of the lightweight fine aggregate, provided the concrete meets the strength and unit weight. A correlation shall also be developed showing the ratio between air dry unit weight and fresh concrete unit weight for each mix.

1.9.4 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This

required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.9.4.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

f'cr = f'c + 1.34S where units are in MPa

f'cr = f'c + 2.33S - 3.45 where units are in MPa

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.9.4.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 20 MPa,

f'cr = f'c + 6.9 MPa

b. If the specified compressive strength f'c is 20 to 35 MPa,

f'cr = f'c + 8.3 MPa

c. If the specified compressive strength f'c is over 35 MPa,

f'cr = f'c + 9.7 MPa

1.9.5 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.9.6 Mix Design for Bonded Topping for Heavy Duty Floors

The concrete mix design for bonded topping for heavy duty floors shall contain the greatest practical proportion of coarse aggregate within the specified proportion limits. The mix shall be designed to produce concrete having a 28-day strength of at least 34.5 MPa. Concrete for the topping shall consist of the following proportions, by weight:

1.00 part portland cement
1.15 to 1.25 parts fine aggregate
1.80 to 2.00 parts coarse aggregate

Maximum w/c shall be 0.33. The topping concrete shall not be air-entrained. The concrete shall be mixed so as to produce a mixture of the driest consistency possible to work with a sawing motion of the strike-off and which can be floated and compacted as specified without producing water or excess cement at the surface. In no case shall slump exceed 25 mm as determined by ASTM C 143.

1.10 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.11 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.11.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of

batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.11.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.11.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.11.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali including false set requirements or Type V. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 5 percent, low alkali. Type III cement shall be used only in isolated instances and only when approved in writing.

2.1.3 Blended Cements

ASTM C 595M , Type IP IS .

2.1.4 Pozzolan (Fly Ash)

ASTM C 618, Class F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalies from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than **25 percent (Am0001)** by weight of the total cementitious material.

2.1.5 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.1.6 Silica Fume

Silica fume shall conform to ASTM C 1240. Available alkalies shall conform to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. In accordance with paragraph Technical Service for Specialized Concrete, the Contractor shall provide at no cost to the Government the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation 5.

2.2.3 Materials for Bonded Topping for Heavy Duty Floors

In addition to the requirements specified above, coarse aggregate used for this purpose shall be a well graded, hard, sound diabase, trap rock, emery, granite or other natural or manufactured aggregate having equivalent hardness and wearing qualities and shall have a percentage of loss not to exceed 30 after 500 revolutions when tested in accordance with ASTM C 131. Gradation of the aggregates when tested in accordance with ASTM C 136 shall be as follows:

Coarse Aggregate

Sieve Size	Cumulative Percent By Weight Passing
19 mm	100
12.5 mm	50-100
9.5 mm	25-50
4.75 mm	0-15
2.36 mm	0-8

Fine Aggregate

Sieve Size	Cumulative Percent By Weight Passing
9.5 mm	100
4.75 mm	95-100
2.36 mm	65-80
1.18 mm	45-65
0.600 mm	25-45
0.300 mm	5-15
0.150 mm	0-5

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the

appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies. **If High-Range Water Reducers are used, they will be added on site. (Am0001)**

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A , and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the 0.6 mm sieve to particles passing the 2.36 mm sieve.

2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.11 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.12 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV.

2.13 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.15 mm (6 mils) or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per Pascal per second per square meter (0.5 perms) as determined in accordance with ASTM E 96.

2.14 JOINT MATERIALS

2.14.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 . Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 02760 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS .

2.14.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

2.15 SYNTHETIC FIBERS FOR REINFORCING

Synthetic fibers shall conform to ASTM C 1116, Type III, Synthetic Fiber, and as follows. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials. Fibers shall have a specific gravity of 0.9, a minimum tensile strength of 480 MPa graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement.

2.16 DRY SHAKE FLOOR TOPPING MATERIAL

Dry shake floor topping material shall be a premixed ready-to-use dry shake. It shall be proportioned, mixed and packaged at the factory, and delivered to the jobsite in sealed, moisture resistant bags, ready to apply, finish and cure. The manufacturer of the dry shake material shall have at least 10 years experience in the manufacture of such material. Any material from a manufacturer who makes any disclaimer of the materials performance shall not be used.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is

to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02315EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the 2.36 mm sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 700 kPa plus or minus, 70 kPa, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface

shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

A stream of water under a pressure of not less than 20 MPa shall be used for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Wet sandblasting shall be used after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 50 mm layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall be batched and mixed onsite, or close to onsite, and shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located on site in the general area indicated on the drawings . The batching, mixing and placing system shall have a capacity of at least 50 cubic meters per hour. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first, except that silica fume shall always be batched separately. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices

to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly

discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 CONCRETE PRODUCTION, SMALL PROJECTS

Batch-type equipment shall be used for producing concrete. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall be produced in accordance with ACI 301, and plant shall conform to NRMCA CPMB 100.

3.4 LIGHTWEIGHT AGGREGATE CONCRETE

In addition to the requirements specified for normal weight concrete, lightweight aggregate concrete shall conform to the following. The batching and mixing cycle shall be as directed based on written recommendations from the aggregate supplier which the Contractor shall furnish. Unless otherwise directed, the mixer shall be charged with approximately 2/3 of the total mixing water and all of the aggregate. This shall be mixed for at least 1-1/2 minutes in a stationary mixer or 15 revolutions at mixing speed in a truck mixer. The remaining ingredients shall then be added and mixing continued as specified for normal weight concrete. Lightweight aggregate concrete shall not be vibrated to the extent that large particles of aggregate float to the surface. During finishing, lightweight aggregate concrete shall not be worked to the extent that mortar is driven down and lightweight coarse aggregate appears at the surface. Lightweight aggregate concrete to be pumped shall have a cement content of at least 335 kg per cubic meter. A field trial run of lightweight aggregate concrete placement and finishing shall be made in accordance with ACI 213R.

3.5 FIBER REINFORCED CONCRETE

Fiber reinforced concrete shall conform to ASTM C 1116 and as follows, using the fibers specified in PART 2. A minimum of 0.9 kg of fibers per cubic m of concrete shall be used. Fibers shall be added at the batch plant. The services of a qualified technical representative shall be provided to instruct the concrete supplier in proper batching and mixing of materials to be provided.

3.6 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, or by approved pumping equipment . Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.7 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.7.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters.The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.7.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.7.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.7.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.7.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 900 mm.

The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.7.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.8 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.8.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.8.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at

least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segration or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.8.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.8.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

3.8.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.8.6 Placing Concrete Underwater

Concrete shall be deposited in water by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets shall not be used for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The concrete shall be deposited so that it enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal at start of placing shall not produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow of concrete will be limited to 5 m. Concrete shall not be deposited in running water or in water with a temperature below 2 degrees C.

3.8.7 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.8.8 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017 is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.9 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900 JOINT SEALING.

3.9.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 18 meters. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.9.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations or sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete.

Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.9.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900 JOINT SEALING.

3.9.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.9.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.10.1 Class A Finish and Class B Finish

Class A finish is required in the following areas, formed surfaces that will be permanently exposed to view. Class B finish is required in the following areas, formed surfaces that will not be exposed or backfilled against. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

3.10.2 Class C and Class D Finish

Class C finish is required in the following areas, formed surfaces that will have soil backfill placed against it. Class D finish is required in the following areas, formed surfaces that will be permanently buried. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

3.11 REPAIRS

3.11.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.11.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class A and B finishes, more than 12 mm in diameter and, for Class C and D finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.11.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective

areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.11.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.11.3 Resinous and Latex Material Repair

In lieu of the portland cement bonding coats specified above, an epoxy resin or a latex bonding agent may be used. .

3.12 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.12.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.12.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.12.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that

exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.12.4 Troweled Finish

The following areas all building slabs shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 3 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.12.5 Superflat Finish

None of the building slabs shall be constructed as superflat floors. Extreme care shall be taken to meet specified tolerances. If necessary, special heavy duty, laser guided machines built especially for this work shall be used and shall have experienced, factory-trained operators. Finishing operations shall include use of long-handled 3 meter "highway type" cutting straightedges plus any other tools necessary to meet the surface tolerance requirements.

3.12.6 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.12.6.1 Broomed

All permanently exposed slab surfaces on the exterior of the building shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.12.6.2 Abrasive Aggregate

Areas as indicated on the drawings shall be given an abrasive aggregate finish. The concrete surface shall be given a float finish. Abrasive aggregate shall then immediately be uniformly sprinkled over the floated surface at a total rate of not less than 1.25 kg per square meter spread in two applications at right angles to each other. The surface shall then be troweled to a smooth, even finish that is uniform in texture and appearance and free from blemishes including trowels marks. Immediately after curing, cement paste and laitance covering the abrasive aggregate shall be removed by steel brushing, rubbing with abrasive stone, or sandblasting to expose the abrasive particles.

3.12.7 Dry Shake Finish

Areas as indicated on the drawings shall be constructed with a dry shake finish. Dry shake floor armoring topping shall be used to surface the floor. The base slab shall be constructed and the dry shake material applied in accordance with the manufacturer's written instructions, which shall be furnished by the Contractor. The dry shake material shall be applied in a two-stage application. Total application shall be at the rate recommended by the manufacturer but at a rate not less than 7.5 kg per square meter. The first application shall be at the rate of two-thirds of the total and shall be applied immediately following floating of total area. The dry shake material shall first be applied to the floated concrete adjacent to forms, entryways, columns, and walls where moisture will be lost first. Dry shake material shall be distributed evenly using an approved mechanical spreader. The material shall not be hand thrown on the surface. Finishing machines with float shoes shall be used as soon as dry shake has absorbed moisture (indicated by darkening of surface); floating shall be done just sufficiently to bring moisture from base slab through the shake. Immediately following floating of the first shake, the remaining one-third of the total specified shake shall be applied in the same manner and machine floated. Surface shall be further compacted by a third mechanical floating if time and setting characteristics will allow. At no time shall water be added to the surface. As surface further stiffens, indicated by loss of sheen, it shall be hand or mechanically troweled with blades relatively flat. All marks and pinholes shall be removed in the final raised trowel operation. Floors finished with dry shake material shall be cured using a curing compound recommended by the manufacturer of the dry shake material. Membrane curing compound shall be applied immediately after the floor surface has hardened sufficiently so surface will not be marred by the application. Compound shall be applied uniformly over the entire surface at a coverage which will provide moisture retention in excess of the requirements of ASTM C 309. When dry, the coating shall be protected from droppings of plaster, paint, dirt, and other debris by a covering of scuffproof, non-staining building paper. Floor shall remain covered and be kept free of traffic and loads for at least 10 days after completion. Adequate provision shall be made for maintaining the concrete temperature at 10 degrees C or above during the curing period. The curing compound shall remain in place for not less than 30 days. The curing compound shall be removed by a manufacturer recommended method prior to turning the facility over to the Government.

3.12.8 Heavy Duty Floors

Areas as indicated on the drawings shall have heavy duty floors constructed as follows:

3.12.8.1 General

Heavy duty floor shall be constructed by placing a heavy duty bonded topping on a base slab which has had a rough slab finish left 50 mm below final grade. Concrete in the base slab shall be thoroughly hardened but not more than 30 hours old. The temperature of the fresh concrete topping shall not vary more than 5 degrees C plus or minus from the temperature of the base slab. The ambient temperature of the space adjacent to the concrete placement and of the base slab shall be between 10 and 30 degrees C.

3.12.8.2 Preparation of Base Slab

The base slab shall be kept continuously damp until topping is placed. The surface of the base slab shall be thoroughly cleaned with an air-water jet immediately before placing the topping. A thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the overlay placing. At the time the neat cement grout is placed, the existing concrete surface shall be

damp but shall have no free water present. The overlay concrete shall be deposited before the grout coat has had time to stiffen.

3.12.8.3 Placing and Finishing

Concrete shall be placed, as nearly as practicable in final position, in a uniform layer. The overlay shall be placed and screeded slightly above the required finished grade, compacted by rolling with rollers weighing not less than 4.5 kg per linear 25 mm of roller width or by approved tamping equipment and finish screeded to established grade. Grid type tampers shall not be used. The concrete, while still green but sufficiently hardened to bear a person's weight without deep imprint, shall be floated to a true even plane with no coarse aggregate visible. Floating shall be performed with an approved disc-type mechanical float which has integral impact mechanism. The surface of the overlay shall then be left undisturbed until the concrete has hardened enough to prevent excess fines from being worked to the top. Joints shall be formed to match those in the base slab.

3.12.8.4 Curing and Protection

Concrete shall be maintained in a moist condition and shall be protected against rapid temperature change, mechanical injury, and injury from rain or flowing water, for a curing period of not less than 10 days. Concrete shall be maintained in a moist condition at temperatures above 10 and below 30 degrees C throughout the specified curing period. Concrete shall be protected from a temperature change greater than 3 degrees C per hour and from rapid drying for the first 24 hours following the removal of temperature protection. Curing activities shall begin as soon as free water has disappeared from the concrete surface after placing and finishing. Curing shall be moist curing accomplished by the following method. Surfaces shall be covered with a double layer of burlap, wetted before placing, and overlapped at least 150 mm. Burlap shall be kept continually wet and in intimate contact with the surface. Burlap shall be kept covered with a polyethylene sheeting at least 0.1 mm thick. All traffic shall be kept from the floor during the curing period and heavy traffic shall be kept off till 28-day age.

3.12.9 Two-Course Floor Construction

Areas as indicated on the drawings shall have floors constructed with two-course construction. Two-course floor shall be constructed by placing a bonded topping on the thoroughly hardened concrete base slab which has been left with a rough slab finish left 50 mm below final grade as shown on the drawings. Topping shall be applied at an approved time late in the contract period. The floor topping mixture shall have a specified compressive strength of 34.5 MPa at 28 days, a 50 mm maximum slump, 12.5 mm maximum size coarse aggregate, and shall be proportioned to obtain required finishability. The surface of the base slab shall be thoroughly cleaned by sandblasting or high-pressure waterjet immediately before placing topping. The temperature of the fresh concrete topping shall not vary more than 5 degrees C plus or minus from the temperature of the base slab. The ambient temperature of the space adjacent to the concrete placement and of the base slab shall be between 10 and 30 degrees C. The base slab shall be kept continuously wet for the first 12 hours during the 24 hour period immediately prior to placing the finished floor. After all free water has evaporated or has been removed from the surface, a grout shall be scrubbed in. The grout shall be a 1:1 mixture of portland cement and sand passing the 2.36 mm sieve mixed to a creamlike consistency. The grout shall be scrubbed into the surface just ahead of the concrete topping placing operation. While the grout is still damp, the top course shall be spread and screeded and darbied or bull floated. When the surface moisture has disappeared, the surface shall then be floated with disc-type power

float with integral impact mechanism followed by a minimum of two power trowelings. Trowel marks left by the machine shall be removed by a final, hard steel troweling by hand. Joints shall be formed to match those in the base slab. Concrete shall be maintained in a moist condition and shall be protected against rapid temperature change, mechanical injury, and injury from rain or water, for a curing period of not less than 10 days. Concrete shall be maintained in a moist condition at temperatures above 10 and below 30 degrees F throughout the specified curing period. Concrete shall be protected from a temperature change greater than 3 degrees C per hour and from rapid drying for the first 24 hours following the removal of temperature protection. Curing activities shall be started immediately as soon as free water has disappeared from the surface of the concrete after placing and finishing. Curing shall be moist curing accomplished by the following method. Surfaces shall be covered with a double layer of burlap, wetted before placing, and overlapped at least 150 mm. Burlap shall be kept continually wet and in intimate contact with the surface. Burlap shall be kept covered with a polyethylene sheeting at least 0.1 mm thick. All traffic shall be kept from the topping during the curing period.

3.13 FLOOR HARDENER

All exposed concrete floors shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried for 14 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, 0.5 kg of the silocofluoride shall be dissolved in 4 liters of water. For subsequent applications, the solution shall be 1.0 kg of silicofluoride to each 4 liters of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

3.14 EXTERIOR SLAB AND RELATED ITEMS

3.14.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 straightedge

held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm. Curing shall be as specified.

3.14.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

3.14.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion joints (12 mm wide) shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.14.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.15 CURING AND PROTECTION

3.15.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for

adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.15.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.15.3 Membrane Forming Curing Compounds

Membrane forming curing compounds shall be used only on surfaces in the following areas, areas that will not receive any additional floor covering. Concrete in the following areas Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 500 kPa, at a uniform coverage of not more than 10 cubic meters per L for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.15.4 Impervious Sheeting

The following concrete surfaces may be cured using impervious sheets: all. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 450 mm wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 300 mm and securely weighted down or shall be lapped not less than 100 mm and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.15.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.15.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.16 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for base plates.

3.16.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.16.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.16.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.16.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.17 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per week thereafter for conformance with ASTM C 1077.

3.17.1 Grading and Corrective Action

3.17.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.17.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.17.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.17.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.17.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

3.17.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air

content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall

immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39 for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as

defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.17.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.17.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.17.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.17.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square meters per

Liter, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.17.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.17.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.17.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 04200

MASONRY
07/92
AMENDMENT 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI SP-66	(1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 62	(1997a) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 67	(1998a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	(1998) Loadbearing Concrete Masonry Units
ASTM C 91	(1998) Masonry Cement
ASTM C 129	(1997) Nonloadbearing Concrete Masonry Units
ASTM C 140	(1998b) Sampling and Testing Concrete Masonry Units
ASTM C 216	(1998) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997ae1) Mortar for Unit Masonry
ASTM C 476	(1998) Grout for Masonry
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation

ASTM C 641	(1982; R 1991) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(1997) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 780	(1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(1989a; R 1998) Sampling and Testing Grout
ASTM C 1072	(1998) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1998c) Rubber Products in Automotive Applications
ASTM D 2240	(1997el) Rubber Property - Durometer Hardness
ASTM D 2287	(1996) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 447	(1992b) Compressive Strength of Masonry Prisms

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Masonry Work; G, RE

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be

resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick; G, RE

Insulation; G, RE

Manufacturer's descriptive data.

Cold Weather Installation; G, RE

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU); G, RE

Clay or Shale Brick; G, RE

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

Anchors, Ties, and Bar Positioners; G, RE

Two of each type used.

Expansion-Joint Materials; G, RE

One piece of each type used.

Joint Reinforcement; G, RE

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Insulation; G, RE

One piece of board type insulation, not less than 400 mm by 600 mm in size, containing the label indicating the rated permeance and R-values.

Portable Panel; G, RE

One panel of clay or shale brick, 600 mm by 600 mm, containing approximately 24 brick facings to establish range of color and texture.

SD-06 Test Reports

Efflorescence Test; G, RE
Field Testing of Mortar; G, RE
Field Testing of Grout; G,RE

Prism tests; G, RE
Masonry Cement; G, RE
Fire-rated CMU; G, RE

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

SD-07 Certificates

Clay or Shale Brick;

Concrete Masonry Units (CMU);

Control Joint Keys;
Anchors, Ties, and Bar Positioners;
Expansion-Joint Materials;
Joint Reinforcement;
Reinforcing Steel Bars and Rods;
Masonry Cement;
Mortar Coloring;
Insulation;
Precast Concrete Items;
Mortar Admixtures;
Grout Admixtures;

Certificates of compliance stating that the materials meet the specified requirements.

Insulation;

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 2.5 m by 1.2

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties,

CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show parging . Panels that represent reinforced masonry shall contain a 600 mm by 600 mm opening placed at least 600 mm above the panel base and 600 mm away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather and shall conform to the moisture content as specified in ASTM C 90when delivered to the jobsite. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or

dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 SPECIAL INSPECTION

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.

b. Mortar joint widths shall be maintained as specified.

c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.

d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.

e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.

f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.

g. Additional metric guidance shall conform to Section 01415 METRIC MEASUREMENTS.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for the first six exterior courses above grade. Grade SW or MW shall be used in other brickwork. Brick shall be

tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 62. Brick size shall be modular and the nominal size of the brick used shall be 66.7 mm thick, 100 mm wide, and 200 mm long. Minimum compressive strength of the brick shall be 17.5 MPa

2.2.2 Hollow Clay or Shale Brick

Hollow clay or shale brick shall conform to ASTM C 652, Type HBS . Brick size shall be modular and the nominal size of the brick used shall be 66.7 mm thick, 100 mm (wide, and 200 mm (long. Where vertical reinforcement is shown in hollow brick, the minimum cell dimension shall be 64 mm (2-1/2 inches) and the units shall be designed to provide precise vertical alignment of the cells. Minimum compressive strength of the brick shall be 17.5 MPa (2500 psi).

2.3 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I. Cement shall have a low alkali content and be of one brand.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm (1 inch). Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.3.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

	Minimum equivalent thickness in mm (inches) for fire rating of:		
Aggregate Type	4 hours	3 hours	2 hours

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Pumice	120 (4.7)	100 (4.0)	75 (3.0)
Expanded slag	130 (5.0)	110 (4.2)	85 (3.3)
Expanded clay, shale, or slate	145 (5.7)	120 (4.8)	95 (3.7)
Limestone, scoria, cinders or unexpanded slag	150 (5.9)	130 (5.0)	100 (4.0)
Calcareous gravel	160 (6.2)	135 (5.3)	105 (4.2)
Siliceous gravel	170 (6.7)	145 (5.7)	115 (4.5)

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in millimeters . Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.4 PREFACED CONCRETE MASONRY UNITS

Prefaced concrete masonry units shall conform to ASTM C 744 using masonry units conforming to ASTM C 90, Type 1. The facing shall turn over the edges and ends of the unit at least 10 mm (3/8 inch) in the direction of the thickness of the unit to form a lip at least 2 mm (1/16 inch) thick. Variation in color and texture shall not exceed that of the approved samples. All shapes and sizes shall be provided for a complete installation. Bullnose units shall be used along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings. Radius of the bullnose shall be 25 mm (1 inch). Base units shall be coved to meet finished floor surfaces where ceramic tile floor occurs.

2.5 PRECAST CONCRETE ITEMS

Trim, lintels, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 28 MPa (4000 psi) minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm (1/2 inch) to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 20 mm shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa (120 psi) for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 35 kg shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units

exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.5.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure.

2.5.2 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.6 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the 2.36 mm sieve and 95 percent passing the 1.18 mm sieve. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.7 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.7.1 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.8 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

2.8.1 Wire Mesh Ties

Wire mesh for tying 100 mm (4 inch) thick concrete masonry unit partitions to other intersecting masonry partitions shall be 13 mm (1/2 inch) mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 300 mm.

2.8.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm (3/16 inch) diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm (4 inches) wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm (3/16 inch) diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm (1/2 inch) eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm (1/16 inch). The pintle and eye elements shall be formed so that both can be in the same plane.

2.8.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 5 mm (3/16 inch) diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.8.4 Adjustable Anchors

Adjustable anchors shall be 5 mm (3/16 inch) diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm (5/16 inch) diameter steel bars placed to provide 2 mm (1/16 inch) play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.8.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.9 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm (16 inches). Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m (10 feet) long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.10 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.11 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm (5/8 inch) thick and 10 mm (3/8 inch) thick flanges, with a tolerance of plus or minus 2 mm (1/16 inch). The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C (minus 30 degrees F) after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.12 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900JOINT SEALING.

2.13 INSULATION

2.13.1 Rigid Board-Type Insulation (am#1)

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyurethane or polyisocyanurate **shall conform to ASTM C 1289, Type I, Class 1 or 2, (am#1)** faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.13.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 50 mm, and a minimum air space of 20 mm (3/4 inch).

2.13.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 2 (11) for the overall thickness. The aged R-value shall be determined at 24 degrees C (75 degrees F) in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.13.1.3 Recovered Material

Insulation shall contain the highest practicable percentage of recovered material derived from solid waste (but material reused in the manufacturing process cannot be counted toward the percentage of recovered material). Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of 9 percent by weight of the core material.

2.13.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.14 FLASHING

Flashing shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.15 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 10 mm (3/8 inch mortar joint.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 4 to 0 degrees C. Sand or mixing water shall be heated to produce mortar temperatures between 4 degrees C and 49 degrees C.

b. Air Temperature 0 to minus 4 degrees C. Sand and mixing water shall be heated to produce mortar temperatures between 4 degrees C and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature minus 4 to minus 7 degrees C. Sand and mixing water shall be heated to provide mortar temperatures between 4 degrees C and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour.

d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4

degrees C and 49 degrees C. Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C. Temperature of units when laid shall not be less than minus 7 degrees C.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 4 degrees C to 0 degrees C. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 0 degrees C to minus 4 degrees C. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature minus 4 degrees C to minus 7 degrees C. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 400 mm ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and

sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm (1 gm per minute per square inch) of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	3 mm
In 3 m	6 mm

TOLERANCES	
In 6 m	10 mm
In 12 m or more	13 mm
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 6 m	6 mm
In 12 m or more	13 mm
Variation from level for bed joints and top surfaces of bearing walls	
In 3 m	6 mm
In 12 m or more	13 mm
Variations from horizontal lines	
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	6 mm
Plus	13 mm

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm (3/8 inch) joints.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 100 mm (4 inches) above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 100 mm (4 inch) nominal thick units shall be tied to intersecting partitions of 100 mm (4 inch) units, 125 mm into partitions of 150 mm (6 inch) units, and 175 into partitions of 200 mm (8 inch) or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 100 mm (4 inches) thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 100 mm of coarse aggregate or 250 mm of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than 600 mm on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm (16 inches) on center vertically and 600 mm (24 inches) on center horizontally. Unit ties shall be spaced not over 600 mm (24 inches) on centers horizontally, in courses not over 400 mm (16 inches) apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable

mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 400 mm (16 inches) on center or as indicated. Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm (16 inches) on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.5 m. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm (32 inches) where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed in accordance with the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm (3/4 by 3/4 inch) groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous

bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 20 mm; backer rod and sealant shall be installed in accordance with Section 07900 JOINT SEALING. Exposed interior control joints shall be raked to a depth of 6 mm . Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 3 m and installed with a 6 mm gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 1.2 m, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 15 mm above the bottom inside surface of the lintel unit.

3.14.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 200 mm (8 inches) unless otherwise indicated on the drawings.

3.15 SILLS

Sills shall be set in a full bed of mortar with faces plumb and true.

3.16 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.16.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm (16 inches) on centers vertically and 600 mm (24 inches) on center horizontally.

3.16.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm (16 inches) on centers vertically, and if applicable, not over 600 mm (24 inches) on centers horizontally.

3.17 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing

with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.18 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.19 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.19.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.19.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 milliliters trisodium phosphate and 30 milliliters laundry detergent to 1 liter of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.20 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300CAST-IN-PLACE STRUCTURAL CONCRETE.

3.21 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.22 TEST REPORTS

3.22.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.22.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

3.22.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

3.22.4 Prism Tests

At least one prism test sample shall be made for each 465 square meters of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ASTM E 447. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall not be less than 21 MPa at 28 days. If the compressive strength of any prism falls below the specified value by more than 3.5 MPa, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 3.5 MPa below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

-- End of Section --

SECTION 07131

ELASTOMERIC MEMBRANE WATERPROOFING
09/98
AMMENDMENT 0001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1993; R 1998) Rubber Products - Chemical Analysis
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1998el) Rubber Property - Effect of Liquids
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1171	(1999) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimen)
ASTM D 4637	(1996) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Waterproofing;

Detail drawings showing size of sheets, position of sheets and splices, flashing and termination details, and expansion joint details.

SD-03 Product Data

Installation;

Manufacturer's instructions for installation of the elastomeric membrane, including procedures for preparing the membrane for use, flashing, and splicing. Instructions shall include recommended or required protective covering and procedures for safe handling and use of cleaners, adhesives, and sealants.

SD-07 Certificates

Materials;

Certificates of compliance attesting that the materials meet specification requirements. Certificates may show qualification of the identical compound in the specified test.

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered to the job site in unopened containers bearing the manufacturer's name, brand name, and description of contents. Membrane, flashing, and adhesives shall be stored in clean, dry areas. Storage temperature for adhesives shall be between 16 and 27 degrees C. Protection board shall be stored flat and off the ground.

PART 2 PRODUCTS

2.1 MATERIALS

Adhesives, mastics, cements, tapes, and primers shall be as recommended by the membrane manufacturer and shall be compatible with the material to which they are to be bonded.

2.1.1 Performance Requirements

All membranes shall meet the following requirements when tested by the referenced ASTM standards:

ASTM E 154 Puncture Resistance	178 N (40 pounds), (min.)
ASTM E 96, Procedure B Water Vapor Transmission at 27 degrees C Permeance	14.4 ng per Pa per sec per sq. meter (0.25 perms), (max.)
ASTM G 21 or ASTM E 154 Resistance to Soil Bacteria or Fungi	No sustained growth or discoloration after 21 days

2.1.1.1 Butyl Rubber

Thickness, plus or minus 10 percent	1.5 mm
ASTM D 297	

Specific Gravity	1.2 plus or minus 0.05
ASTM D 412 Tensile Strength	8275 kPa (1200 psi) (min.)
ASTM D 624 Elongation	300 percent (min.)
ASTM D 624 Tear Resistance	21 900 Newtons per m (125 lb./inch) (min.)
ASTM D 471 Water Absorption 168 hours @ 40 degrees C	plus 2 percent (max.)
ASTM D 1171 Ozone Resistance 50 pphm in air 100 hours @ 40 degrees C	20 percent

2.1.1.2 Plastic Elastomeric Sheeting

Membrane shall be a minimum of 1.42 mm thick and shall meet the following requirements:

ASTM D 412, Die C Textile Strength	1520 kPa (220 psi) (min.)
ASTM D 412, Die C Elongation	250 percent (min.)
ASTM D 1004 Tear Resistance	61 300 Newtons per m (350 lb./inch) (min.)

2.1.1.3 Composite Self-Adhering Membrane

Membrane shall be a polymeric sheeting integrally bonded to rubberized asphalt with a minimum thickness of 1.5 mm.

2.1.1.4 Chlorinated Polyethylene (CPE) Sheeting

Membrane shall be uncured chlorinated polyethylene, synthetic elastomeric sheeting of 0.5 mm nominal thickness.

2.1.1.5 Chloroprene

Chloroprene membrane shall conform to ASTM D 4637, Type II, Grade 1, Class U, 1.5 mm minimum thickness.

2.1.1.6 Ethylene Propylene Diene Monomer (EPDM) Membrane

EPDM membrane shall conform to ASTM D 4637, Type I, Grade I, Class U, 1.5 mm minimum thickness.

2.1.2 Protection Board

Protection board for waterproofing membrane shall be 13 mm minimum asphalt plank 13 mm fiberboard 25 mm thick polystyrene foam insulation or premolded bituminous protection board; 3 mm thick for vertical surfaces, and 6 mm thick for horizontal surfaces.

2.2 ACCESSORIES

Flashing, counterflashing, expansion joint covers and corner fillets shall be as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Surfaces to which waterproofing is to be applied shall be clean, smooth, and free from deleterious materials and projections. Holes, honeycomb, cracks, or cavities shall be pointed or filled and finished flush with Portland cement mortar. Top surfaces of projecting masonry or concrete ledges below grade, except footings, shall be beveled. Before waterproofing is applied, the surfaces to be covered shall be swept to remove all dust and foreign matter. Concrete surfaces shall be cured 30 days prior to receiving elastomeric waterproofing and shall not be cured with compounds containing wax or oil. Masonry surfaces to be waterproofed shall have joints struck flush.

3.2 APPLICATION

Waterproofing shall not be applied to wet surfaces. The ambient and surface temperatures shall be above 4.5 degrees C during application. Membrane under slabs shall be carried up abutting vertical surfaces to the level of finish of floor or to within 13 mm of the top edge of base where base is shown and cemented solid to the substrate. Membrane shall not be continuous through walls, floors, piers, and columns unless otherwise shown. Concrete surfaces shall be primed to receive the membrane. Membranes shall be handled and installed in accordance with the approved installation instructions. Primers, adhesives, and mastics shall be applied in accordance with the membrane manufacturer's printed instructions. Laps shall be oriented so that water will flow over the lap, and not into them. As soon as the mastic is fully set and dry, joints shall be checked. Where any openings or fishmouths appear, joints shall be resealed and rerolled. Wrinkles and buckles shall be avoided in applying membrane and joint reinforcement. Nonadhering membranes shall be unrolled and allowed to remain flat for at least 2 hours before application. Membranes shall be drawn tight during installation without stretching. Self-adhering membrane shall be installed by removing the release sheets on the back of the membrane and applying the tacky surface onto the primed surface. Laps and splices shall be sealed prior to completion of a day's work.

3.2.1 Butyl Rubber Installation

Each sheet shall be lapped at sides and ends a minimum of 150 mm over the preceding sheet. Lap and splice areas of membrane shall be cleaned with heptane, hexane, or white gasoline. Unvulcanized compounded butyl tape, 150 mm wide shall be applied between lapped splices so that the tape extends approximately 6 mm beyond the exposed sheeting edge. The tape shall be rolled firmly into place as it is applied. Tape backing shall be removed and the lapped sheeting rolled or pressed into place. Splicing adhesive shall be applied to the lapped area 90 mm on either side of the lapped edge. The splice adhesive shall be allowed to dry thoroughly and the lap reinforced with 150 mm wide unvulcanized compounded butyl tape. Full contact shall be made for all lap areas. Corner splices and flashing overlaps shall be reinforced with a 300 mm wide strip of membrane over one layer of butyl tape or with a prefabricated corner of butyl rubber.

3.2.2 Plastic Elastomeric Sheeting Installation

Sheeting shall be applied in sections no longer than 5400 mm. Each sheeting shall be lapped at sides and ends a minimum of 150 mm over the

preceding sheet. Lap splices shall be reinforced with 300 mm wide strips of plastic sheeting or as recommended in the approved installation instructions. Lap and splices shall be sealed in a full bed of adhesive at the rate recommended by the manufacturer of the material. Sheeting and joint strips shall be rolled with 150 mm rubber hand roller on vertical surfaces.

3.2.3 Composite Self-Adhering Membrane Installation

On vertical surfaces, membrane shall be applied in lengths up to 2400 mm starting at the bottom. Each sheet shall be lapped at edges and ends a minimum of 65 mm over the preceding sheets. The membrane shall be rolled to adhere with the substrate. Corners and joints shall be double-covered by first applying a 300 mm width of membrane centered along the corner or joint. Inside and outside corners shall then be covered with membrane. Exposed termination edges of membrane on horizontal or vertical surfaces shall be finished with a troweled bead of mastic. Mastic shall be applied around termination edges of membrane and around drains and projections. Mastic shall be applied at the termination of each day's work.

3.2.4 Chlorinated Polyethylene (CPE) Sheeting Installation

Sheets shall be lapped at edges and ends a minimum of 65 mm over the preceding sheet. All horizontal membranes shall overlap vertical surfaces by at least 75 mm.

3.2.5 Chloroprene Rubber Sheeting

Each sheet shall overlap the previously installed sheet by a minimum of 75 mm. Sheet shall be folded lengthwise to expose one half of the underside of the sheet for cleaning the sheet with cleaner recommended by the manufacturer. Adhesive shall be applied to sheet and substrate. Two coats of adhesive are required on the substrate with 1/2 hour between coats. Sheet shall not be bonded to substrate until adhesive does not come off at a dry finger touch. Chalk lines or masking tape shall be used as guides for adhesive application and positioning sheets. After adhesive has dried, sheet shall be folded back onto the substrate or previously applied sheet membrane. Membrane shall be rolled to obtain complete adhesion. The exposed edge of each sheet shall be further sealed with a fillet-shaped bead of adhesive, tooled to obtain positive contact with the surface of both sheets.

3.3 TESTS

When required, and after the system is cured, the membranes on horizontal surfaces shall be tested by flooding the entire waterproofed area with a minimum of 50 mm head of water for a period of 24 hours. There shall be no water added after the start of the period. Water level shall be measured at the beginning and at the end of the 24 hour period. If the water level falls, remove the water and inspect the waterproofing membrane. Leak sites shall be marked, dried and repaired, and the test shall be repeated.

3.4 PROTECTION

Horizontal applications of membrane shall be protected from traffic during installation. No equipment shall be allowed directly on the membrane. Plywood, or similar material, overlayment shall be provided for wheel-ways. Walkways shall be provided where heavy traffic from other trades is expected. Materials shall not be stored on the membrane. A protective covering shall be installed over the membrane immediately after installation or testing. If membrane is to be exposed, a temporary covering shall be applied to protect the membrane until the protection

board is installed.

3.4.1 Projections

Projections passing through membrane shall be flashed as recommended by the manufacturer of the waterproofing membrane.

3.4.2 Counterflashing

Waterproofing connecting with work exposed to the weather shall be counterflashed to form a watertight connection. Upper edge of membrane waterproofing and protective covering shall be counterflashed.

3.4.3 Expansion Joints and Fillets

Expansion joints and corner fillets shall be installed as recommended by the manufacturer of the waterproofing membrane.

3.4.4 Vertical Membrane Waterproofing

Waterproofing shall be protected with a 13 mm minimum fiberboard 13 mm asphalt-impregnated fiberboard 25 mm polystyrene foam insulation or 3 mm compatible water-resistant (bitumen type) protection board. Edges of protection shall be butted, and exposed surfaces shall be covered by a coating of bitumen.

3.4.5 Horizontal Membrane Waterproofing

Waterproofing shall be covered with Portland cement mortar not less than 20 mm thick, uniformly placed, and allowed to set before subsequent construction is installed.

-- End of Section --

SECTION 09915

COLOR SCHEDULE
06/93
AMENDMENT 0001

PART 1 GENERAL

1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Color Schedule; G

FOUR (4) sets of color boards, 120 days after the Contractor is given Notice to proceed, complying with the following requirements:

a. Color boards shall reflect all actual finish textures, patterns, and colors required for this contract.

b. Materials shall be labeled with the finish type, manufacturer's name, pattern, and color reference.

c. Samples shall be on size A4 or 8-1/2 by 11 inch boards with a maximum spread of size A1 or 25-1/2 by 33 inches for foldouts.

d. Samples for this color board are required in addition to samples requested in other specification sections.

e. Color boards shall be submitted to the following address:
ARCHITECTURAL SECTION
DESIGN BRANCH
FORT WORTH DISTRICT

PART 2 PRODUCTS

2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal

colors from other manufacturers.

2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

a. Brick: ACME; ELGIN, PAINTED DESERT

b. Mortar: STANDARD

c. Insulation and Finish System: STO; PACFIC SAND, 10511, TEXTURE STOLI TR1.5

d. Architectural Concrete: To match Cast Stone, Buff

2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

a. Doors and Door Frames: TO MATCH GRAHAM ARCH. PRODUCTS; ANTIQUE BRONZE.

   METAL DOORS TO BE PAINTED TO MATCH STANDING SEAM ROOF, TERRA COTTA.

b. Windows (mullion, muntin, sash, trim, and sill): TO MATCH GRAHAM ARCH. PRODUCTS. ANTIQUE BRONZE

c. Downspouts, Gutter, Louvers, and Flashings: TO MATCH STANDING SEAM ROOF, AMERICAN BLDGS. COMPANY, TERRA COTTA

d. Soffits and Ceilings: STO; PACFIC SAND 10511, TEXTURE; STOLITR1.5

e. Signage: BASE STANDARDS

f. Caulking and Sealants: SHALL MATCH SURROUNDING MATERIALS.

2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

a. STANDING SEAM Metal: AMERICAN BUIDLINGS COMPANY, TERRA COTTA

2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

a. Carpet Tile: INTERFACE; CHENILLE WARP CIRCLES, YESTERDAY

b. Vinyl Composition Tile: Armstrong; Imperial Texture, Sandrift White 51858

c. Ceramic Tile: CTF-1; DAL-TILE; KEYSTONES, SPICE D022 50 X 50 mm

NOTE: TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

d. Porcelain Tile: F7 PTF-1; DAL-TILE; ROCKY MOUNTAIN, BEIGE 803 UNPOLISHED

NOTE: TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

e. Grout: MAPEI; CHAMOIS 05

NOTE: GROUT TO BE SEALED WITH DOMINION PENATRATING CONCRETE SEALER OR AN EQUAL

f. Concrete: WITH HARDNER

2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

a. Resilient Base and Edge Strips:B1
RB1; JOHNSONITE; TIGHTLOCK, ROASTED PEPPER TCB-94
RB2; JOHNSONITE; TIGHTLOCK, BONE WHITE 79

b. Ceramic Tile: B3AL-TILE; KEYSTONES, MB-5A, SPICE

c. Porcelain Tile: B4: DAL-TILE; ROCKY MOUNTAIN, BULLNOSE S-44C9, BEIGE 803, UNPOLISHED

d. Grout: MAPEI; CHAMOIS 05

NOTE: GROUT TO BE SEALED WITH DOMINION PENATRATING CONCRETE SEALER OR AN EQUAL.

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

a. Paint:W8
P-1; POLYMIX, PW-QS023
P-2; SHERWIN WILLIAMS; VELLUM SW1116
P-3; SHERWIN WILLIAMS; RENOIR RED SW1609
P-4; SHERWIN WILLIAMS; BYZANTIUM SW1524

b. Vinyl Wall Covering:W9
VWC-1; TRI-KES/VERSA; BURMA, CINNABAR E03-119
VWC-2; TRI-KES/LEN-TEX; BELLINGHAM, RED EARTH 7625 BT

c. Wall Covering:W10
WC-1; MAHARAM; TEK WALL TRANCE 395660, SUMAC 004

d. Ceramic Tile:W3
CTW-1; DAL-TILE; SEMI-GLOSS, CHAMOIS K-180 (FIELD)100 X 100mm
CTW-2; DAL-TILE; SEMI-GLOSS, COTTO Q181 (ACCENT BAND)150 x 150mm

NOTE: SEE ARCH. DRWGS. I 01 FOR WALL PATTERN.

e. Ceramic Tile Grout: MAPEI; CHAMOIS 05

f. PORCELIAN TILE:
PTW-1; DAL-TILE; ROCKY MOUNTAIN, BEIGE 803, SEMI-POLISHED
PTW-2; DAL-TILE; ROCKY MOUNTAIN, BEIGE 803, UNPOLISHED

NOTE: SEE ARCH. DRWGS. I 01 FOR WALL PATTERN

g. PORCELAIN GROUT: MAPEI; CHAMOIS 05

NOTE; GROUT TO BE SEALED WITH DOMINION PENATRATING CONCRETE SEALER OR AN EQUAL

2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

a. Acoustical Tile and Grid: C3ARMSTRONG; ULTIMA, BEVELED TEGULAR, 9/16 #1912M, 600 X 600 X 19 MM, WHITE

b. Paint:C2 P-2; SHERWIN WILLIAMS, VELLUM SW1116

2.2.8 Interior Trim

Interior trim shall be provided to match the colors listed below.

a. Doors: P-2; SHERWIN WILLIAMS, VELLUM SW1116
METAL/ALUM; TO MATCH GRAHAM ARCH. PRODUCTS, ANTIQUE BRONZE

b. Door Frames: P-2; SHERWIN WILLIAMS, VELLUM SW1116
METAL/ALUM; TO MATCH GRAHAM ARCH. PRODUCTS, ANTIQUE BRONZE

c. Windows (mullion, muntin, sash, trim, and stool): TO MATCH GRAHAM ARCH. PRODUCTS, ANTIQUE BRONZE.

d. Window Sills: P-2; SHERWIN WILLIAMS, VELLUM SW1116

2.2.9 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

a. WINDOW SHADES: MECHO; EUROVEIL; BRONZE 5313

NOTE: ALL EXTERIOR WINDOWS TO HAVE THE ABOVE WINDOW SHADES INSTALLED.

2.2.10 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

a. Toilet Partitions and Urinal Screen: BOBRICK; DOESKIN TAN

b. Plastic Laminate:
PL-1; WILSONART; NATURAL TIGRIS 4668-60; COUNTERTOPS
PL-2; WILSONART; PORT D14-60; COUNTERTOPS IN TOILET AREAS

c. Signage Message Color (excluding handicapped signage): BASE STAMDARD

d. Signage Background Color (excluding handicapped signage): BASE STANDARD

e. Lockers: LYON, TAN

f. Operable Partitions: W4 MODERNFOLD; COLOR TO MATCH SOUND SYSTEMS ACOUSTICAL WALLCOVERINGS BY VERTEX, SANDALWOOD SV512

g. Wall Switch Handles and Standard Receptacle Bodies: IVORY

h. Electrical Device Cover Plates and Panels: IVORY

i. Casework:
RECEPTION DESK AND OTHER COUNTERTOPS; SEE ARCH. DRWG. A59 DETAIL 11
RESTROOM VANITY; SEE ARCH. DRWG A60 DETAIL 9

j. Shower Curtain: BEIGE

2.3 ROOM COLOR AND FINISH SCHEDULE

COMPANY OPS BUILDINGS

Area: Vestibule A,C,E 101

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PB	PTF-1	VWC-2	VWC-2	VWC-2	VWC-2	ATC
		AM1 CTF-1		Glazing		Glazing	

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Waiting A,C,E 102

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PB	PTF-1	P-4	P-4	P-3	-	ATC
		AM1 CTF-1		Glazing	P-4		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Corridor A,C,E 103

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PB	PTF-1	P-4	-	P-4	VWC-1	ATC
		AM1 CTF-1					

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area:	Administration A,C,E 104						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	Training A,C,E 105						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC
Area:	First Sergeant A,C,E 106						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC
Area:	Executive Officer A,C,E 107						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC
Area:	Commanding Officer A,C,E 108						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC
Area:	Corridor A,C,E 109						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	-	VWC-2	VWC-2	VWC-2	ATC
Area:	Storage A,C,E 110						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2
Area:	Janitor Storage A,C,E 111						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	P-2

SEE ARCH. DRWG I 01 FOR WALL PATTERN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Storage A,C,E 112						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT-1	P-2	P-2	P-2	P-2	P-2
Area:	Storage A,C,E 113						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT-1	P-2	P-2	P-2	P-2	P-2
Area:	Conference A,C,E 114						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	WC-1	WC-1	WC-1	WC-1	ATC
Area:	Platoon Office A,C,E 115						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC
Area:	Platoon Office A,C,E 116						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Platoon Office A,C,E 117						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling

Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Corridor A,C,E 118

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT		VWC-1	VWC-1	VWC-1	ATC

Area: Toilet/Shower A,C,E,119

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Toilet/Shower A,C,E 120

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Janitor A,C,E 121

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1	CTW-1	CTW-1	CTW-1	P-2
			CTW-2	CTW-2	CTW-2	CTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTRN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Telephone A,C,E 122

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	ATC

Area: Vestibule A,C,E 123

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Vestibule A,C,E 124

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Women's A,C,E 125

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Men's A,C,E 126

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR WALL TILE PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Equipment Maintenance A,C,E 127

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2 WIRE PARTITION	P-2	P-2 WIRE PARTITION	P-2	EXPOSED P-2

Area: Com Storage A,C,E 128

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	WIRE PART.	WIRE PART.	EXPOSED P-2

Area: NBC Storage A,C,E 129

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	WIRE PART.	WIRE PART.	WIRE PART.	EXPOSED P-2

Area: TA-50 A,C,E 130

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	WIRE PART.	WIRE PART.	P-2	EXPOSED P-2

Area: Arms Vault A,C,E 131

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	REINF. CONC. P-2

Area: Unit Storage A,C,E 132

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	CONC	P-2 WIRE PART.	WIRE PART.	P-2	P-2	EXPOSED P-2

Area: General Storage A,C,E 133

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	WIRE PART.	P-2	P-2	WIRE PART.	EXPOSED P-2

Area: Mechanical A,C,E 134

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	EXPOSED P-2

Area: Electrical A,C,E 135

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area: Vestibule B,D,F 101

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1 **AM1 CTF-1**	VWC-2	P-1 GLAZING	VWC-2	P-1 GLAZING	P-2

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Waiting B,D,F 102

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1 **AM1CTF-1**	P-3	P-4 GLAZING	P-4	-	ATC

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Corridor B,D,F 103

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-3	-	P-4	P-4	ATC

AM1 CTF-1

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Adminstration B,D,F 104

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: Training B,D,F 105

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: First Sergeant B,D,F 106

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Executive Officer B,D,F 107

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Commanding Officer B,D,F 108

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Corridor B,D,F 109

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	VWC-2	VWC-2	-	VWC-2	ATC

Area: Storage B,D,F 110

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area: Janitor Storage B,D,F 111

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	P-2

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
NOTE; FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Storage B,D,F 112

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-2	P-2	P-2	P-2	P-2

Area: Storage B,D,F 113

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-2	P-2	P-2	P-2	P-2

Area: Conference B,D,F 114

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	WC-1	WC-1	WC-1	WC-1	ATC

Area: Platoon Office B,D,F 115

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Platoon Office B,D,F 116

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: Platoon Office B,D,F 117

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1 GLAZING	P-1	P-1	ATC

Area: Corridor B,D,F 118

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: Toilet/Shower B,D,F 119

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Toilet/Shower B,D,F 120

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Janitor B,D,F 121

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	CTW-1 CTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN

Area: Telephone B,D,F122

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	VCT	P-2	P-2	P-2	P-2	ATC

Area: Vestibule B,D,F 123

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWGI 01 FOR PATTERN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Vestibule B,D,F 124

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Women's B,D,F 125

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGEE ANGLE

Area: Men's B,D,F 126

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Equipment Maintenance B,D,F 127

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2 WIRE PARTITION	P-2	P-2 WIRE PARTITION	P-2	EXPOSED P-2

Area: Com Storage B,D,F 128

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	WIRE PARTITION	P-2	P-2	WIRE PARTITION	EXPOSED P-2

Area: NBC Storage B,D,F 129

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	WIRE PART	WIRE PART	P-2	WIRE PART	EXPOSED P-2

Area: TA-50 B,D,F 130

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	WIRE PART	WIRE PART	P-2	P-2	EXPOSED P-2

Area: Arms Vault B,D,F 131

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	EXPOSED P-2

Area: Unit Storage B,D,F 132

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	WIRE PART	P-2 WIRE PART	P-2	EXPOSED P-2

Area: General Storage B,D,F 133

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	WIRE PART	WIRE PART	EXPOSED P-2

Area: Mechanical B,D,F 134

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	EXPOSED P-2

Area: Electrical B,D,F 135

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	VCT	P-2	P-2	P-2	P-2	P-2

BATTALION COMMAND BLDG.

Area: Vestibule G101

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	VWC-2	P-1	VWC-2	P-2
		AM1 CTF-1	GLAZING		GLAZING		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Corridor G102

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	P-1	P-1	P-1	P-2
		AM1 CTF-1	GLAZING		GLAZING		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Corridor G103

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	-	P-1	-	P-2
		AM1 CTF-1					

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Men's Tlt G104

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Women's Tlt G105

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWG I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Corridor G106

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1		P-1	P-1	P-1	P-2

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Lounge G107

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	P-1	VWC-2	P-1	ATC
		AM1 CTF-1					

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Tele G108

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	VCT	P-2	P-2	P-2	P-2	ATC

Area: Vending G109

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	VWC-2	VWC-2	-	VWC-2	ATC

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Janitor G110						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1	CTW-1	CTW-1	CTW-1	P-2

Area:	Stor G111						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	-	P-2

Area:	Stor G112						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	-	P-2	P-2	P-2	P-2

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Stor G113						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	P-1	-	P-1	P-2

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Stor G114						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1		P-2

Area:	Mech G115						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	EXPOSED P-2

Area:	Elec G116						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	P-2

Area:	Stor G117						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	P-2

Area:	Classroom G118						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	WC-1	WC-1	PW	WC-1	ATC

Area:	Classroom G119						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	PW	WC-1	PW	WC-1	ATC

Area:	Classroom G120						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	PW	WC-1	WC-1	WC-1	ATC

Area:	Resource Ctr G121						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Vestibule G122						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	VWC-2	P-1	VWC-2	P-2
	AM1 CTF-1		GLAZING		GLAZING		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND

PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area:	Chaplain G123						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Chaplain's Asst. G124						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	Vault G125						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	REINF. CONC. P-2
Area:	S-2 Admin. G126						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	S-2 Officer G127						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G128						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G129						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	S-3 Admin. G130						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	S-3 Officer G131						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G132						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G133						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G134						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office G135						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

			GLAZING				
Area:	S-4 Admin G136						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	S-4 Officer G137						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
			GLAZING				
Area:	Office G138						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
			GLAZING				
Area:	Office G139						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
			GLAZING				
Area:	Office G140						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
			GLAZING				
Area:	Corrridor G141						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
				GLAZING		GLAZING	
Area:	Conference G142						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	WC-1	WC-1	WC-1	WC-1	ATC
					GLAZING		
Area:	Electrical G143						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2
Area:	Supplies G144						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	ATC
Area:	Toilet G145						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Storage G146						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-2	P-2	P-2	P-2	P-2
Area:	Commanding Officer G147						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	S-1 Admin G148						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: Executive Officer G149

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Sgt. Major G150

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: S-1 Oficer G151

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Office G152

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Office G153

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Office G154

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Office G155

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Mail/Messsage Ctr. G156

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area: Duty Officer G157

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

BRIGADE HEADQQUARTERS

Area: Vestible H101

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	VWC-2	P-1	VWC-2	P-2
		AM1 CTF-1	GLAZING		GLAZING		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Corridor H102

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	P-1	P-1	P-1	P-2
		AM1 CTF-1	GLAZING		GLAZING		

NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area:	Corridor H103						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	-	P-1	-	ATC

Area:	Re-Enl H104						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Surgeon H105						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Supply H106						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area:	Chaplian H107						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Chaplian's Asst. H108						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Electrical H109						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area:	Shower H110						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Men's Toilet H111						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Women's Toilet H112						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1	PTW-1	PTW-1	PTW-1	P-2
			PTW-2	PTW-2	PTW-2	PTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Janitor H113						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	CT	CTF-1	CTW-1	CTW-1	CTW-1	CTW-1	P-2
			CTW-2	CTW-2	CTW-2	CTW-2	

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	Vending H114						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling

Matl:	PT	PTF-1	P-1 VWC-1	P-1	P-1 VWC-1	VWC-1	P-2 ATC

NOTE: VWC-2 TO BE ONLY ON WALLS IN VENDING COVE
NOTE; PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area: Storage H115

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area: Storage H116

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

Area: Mechanical H118

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	None	CONC	P-2	P-2	P-2	P-2	EXPOSED P-2

Area: Vestibule H119

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	P-1	P-1	P-1	P-1	P-2
	AM1 CTF-1		GLAZING				

AM1 NOTE PORCELAIN FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE
AM1 INSTALL SCHLUTER-SYSTEMS, JOLLY PBC B-100 WHERE CERAMIC AND PORCELAIN TILE ABUT AND AROUND THE PERIMETER OF COLUMN.

Area: Signal H120

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-1	P-1	P-1	P-1	ATC

Area: Vault H121

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	NONE	CONC	P-2	P-2	P-2	P-2	REINF. CONC. P-2

Area: S-2 Admin H122

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: S-2 Officer H123

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC

Area: Office H124

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC

Area: Telephone H125

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	VCT	P-2	P-2	P-2	P-2	ATC

Area: S-3 Admin. H126

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area: S-3 Officer H127

	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC

Area:	Office H128						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office H129						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office H130						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office H131						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	S-4 Admin H132						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	S-4 Officer H133						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office H134						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Office H135						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1 GLAZING	P-1	P-1	P-1	ATC
Area:	Corridor H136						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC
Area:	Conference H137						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	WC-1	WC-1	WC-1 GLAZING	WC-1	ATC
Area:	Supply H138						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	ATC
Area:	Storage H139						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2
Area:	Toilet H140						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	PT	PTF-1	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	PTW-1 PTW-2	P-2

NOTE: SEE ARCH DRWGS I 01 FOR PATTERN
FLOOR TILE TO BE INSTALLED AT A 45 DEGREE ANGLE

Area:	S-1 Admin H141						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Commanding Officer H142						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Executive Officer H143						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Sgt. Major H144						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	S-1 Officer H145						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Office H146						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Office H147						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Office H148						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Message/Mail Ctr. H149						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1 GLAZING	P-1	ATC

Area:	Duty Officer H150						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-1	CPT	P-1	P-1	P-1	P-1	ATC

Area:	Electrical H151						
	Base	Floor	A Wall	B Wall	C Wall	D Wall	Ceiling
Matl:	RB-2	VCT	P-2	P-2	P-2	P-2	P-2

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 13851

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE
08/98
AMENDMENT NO. 0001
10/2001

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41	(1990; R 1996) Audible Emergency Evacuation Signals

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 72	(1996; Errata Oct 96, Dec 96; TIA 96-1, 96-2, 96-3) National Fire Alarm Code
NFPA 90A	(1996) Installation of Air Conditioning and Ventilating Systems
NFPA 1221	(1994) Installation, Maintenance and Use of Public Fire Service Communication Systems

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 38	(1994; Rev Nov 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 228	(1997) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(1996; Rev thru Jun 1998) Smoke Detectors for Fire Protective Signaling Systems

UL 268A	(1998) Smoke Detectors for Duct Applications
UL 464	(1996; Rev May 1997) Audible Signal Appliances
UL 521	(1993; Rev Oct 1994) Heat Detectors for Fire Protective Signaling Systems
UL 632/ANSI C33.41	(1994; Rev Sep 1994) Electrically-Actuated Transmitters
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996) Control Units for Fire-Protective Signaling Systems
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev thru May 1997) Signaling Devices for the Hearing Impaired

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G,

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries; G

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging

period shall be included.

Voltage Drop; G

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts; G

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G

Technical data which relates to computer software.

Training; G

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing; G

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing; G

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment; G

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications; G

Proof of qualifications for required personnel. The installer

shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G
Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike and shall be CAT-15 except fire alarm transmitter is to remain factory keyed.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

b. A registered professional engineer (P.E.) in fire protection engineering.

c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised addressable fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected , , to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that

if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

a. Sufficient memory to perform as specified and as shown for addressable system.

b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors

c. Capability of each addressable device being individually disabled or enabled from the panel.

d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

a. Monitor electrical supervision of SLC, and NAC. Smoke detectors shall have combined alarm initiating and power circuits.

b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.

e. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

f. Confirmation or verification modules used on smoke detection

initiating circuits. The modules shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. All fFire alarm devices other than smoke detectors shall be prohibited on circuits controlled by confirmation or verification modules.

g. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.

h. The fire alarm control panel shall monitor the fire sprinkler system. This applies only to the Battalion Command buildings.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

a. Transmission of signals over the station radio fire reporting system. The signals shall be as follows: (1) Supervisory and Trouble from fire detection system; (2) Supervisory and Trouble from fire protection (sprinkler) system (battalion command buildings only).

b. Visual indications of the alarmed devices on the fire alarm control panel display .

c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.

d. Deactivation of the air handling units throughout the building.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

(1) Identification of programmable portions of system equipment and capabilities.

(2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

(3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

(4) Description of Fire Alarm Control Panel equipment operation.

(5) Description of auxiliary and remote equipment operations.

(6) Library of application software.

(7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red .

2.1.1 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.2 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.3 Addressable Control Module

The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.1.4 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style B initiating device circuits. The system shell be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel . Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 1220 mm. Stations shall be double action type. Stations shall be finished in red, with raised letter

operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key shall be required to reset the station. Key for the manual fire alarm station shall be CAT-15. The use of a wrench or any device other than the CAT-15 key shall not be allowed. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations .

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable including flow and tamper switches. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature. Heat detectors shall be rated

[Amend #1] in accordance with UL 521. Detectors located in areas subject to moisture or exterior atmospheric conditions shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

2.5.1.1 Fixed Temperature Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be designed to detect high heat. The detectors shall have a specific temperature setting of 57.2 degrees C. **Contractor shall provide an additional 5% of total detectors installed as spares to the government. [Amend #1]** The UL 521 test rating for the fixed temperature detectors shall be rated for 4.57 by 4.57 m.

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be ionization type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.2.1 Duct Detectors

Duct detectors are provided under Section 15951, Direct Digital Control for HVAC. Detectors shall be powered from the fire alarm control panel and each shall be provided with an addressable initiating device module.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted red . Notification devices are not required to be addressable.

2.6.1 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box recessed single projector, vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 3.05 m.

2.6.2 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be semi-flush mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.2 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.7.3 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is a Monaco D-700 operating at a frequency of 139.675 MHZ. The transceiver shall be fully compatible with this equipment. The transceiver shall be a BT2-7 or BT2-8. At the contractors option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 48 hours and be capable of transmitting alarms during that period.

2.8.1.2 Radio Alarm Transmitter

Transmitter shall be a Monaco BT2-7. No substitutes.

2.8.1.3 Antenna

The Contractor shall provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h. Antennas shall not be mounted to any portion of the building roofing system.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE

ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm nor more than 2000 mm above the finished floor. Manually operable controls shall be between 900 and 1100 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits. Detectors shall be at least 300 mm from any part of any lighting fixture. Detectors shall be located at least 900 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location .

3.1.5 Notification Appliances

Notification appliances shall be mounted 2003 mm above the finished floor or 150 mm below the ceiling, whichever is lower.

3.1.6 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION NFPA 72, as indicated on the drawings and as specified herein.

3.1.7 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall he mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC control, they shall be within 914mm of the controls as stated in NFPA 72. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION , as indicated on the drawings and as specified herein.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.2.2 Low Voltage DC Circuits Surge Protection

All IDC , except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

a. Test of each function of the control panel.

b. Test of each circuit in both trouble and normal modes.

c. Tests of each alarm initiating devices in both normal and trouble conditions.

d. Tests of each control circuit and device.

e. Tests of each alarm notification appliance.

f. Tests of the battery charger and batteries.

g. Complete operational tests under emergency power supply.

h. Visual inspection of wiring connections.

i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.

j. Ground fault

k. Short circuit faults

l. Stray voltage

m. Loop resistance

3.5 TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of four (4) hours of normal working time and shall start after the system is functionally completed, but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructins, as well as demonstrations of routine maintenance operations. the Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course. This 4-hour course shall be held twice on separate days, so all staff may attend

these classes and shall be held on Tuesday, Wednesday, or Thursday between 0900 and 1500 hours. Classes shall be video taped on VHS tape and tapes shall be turned over to the Contracting Officer. The Contractor shall provide a laptop computer equal to TOSHIBA, Model #4000CDS with Window's 95 standard and the Fire Alarm Control Panel (FACP) manufacturer's software for programming the FACP from the computer. The computer with software amd software manual, all necessary cables and accessories to program the FACP from the computer shall be provided to the Government at the end of the training. In addition to the above training, four (4) hours each day for three (3) training days shall be for instruction in the g of the FACP from the laptop computer. The trainer shall be certified by the FACP manufacturer to instruct in the programming of the FACP from a laptop.

-- End of Section --